

# UNITED STATES AIR FORCE RESEARCH LABORATORY

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## IDENTIFYING FUTURE TRAINING TECHNOLOGY OPPORTUNITIES USING CAREER FIELD MODELS AND SIMULATIONS

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14. ABSTRACT The military continues to face substantial reductions in training and operational resources. Of particular concern are reductions in the budget for in-residence initial skills and follow-on training courses. Although advanced training technologies offer opportunities for reducing the time required for a given course while maintaining levels of proficiency, technology is not a solution in and of itself. This report presents results from a recent application of a career field education and training planning simulation capability to identify cost-effective opportunities for the introduction of advanced training technology to reduce time-to-train and overall training costs. The report also discusses the importance of life-cycle modeling of entire career fields and important cost and utility factors for deriving total training costs and relative return-on-investment timelines. Implications for large-scale implementation of advanced training technology for restructuring future training are highlighted and discussed.					
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# **IDENTIFYING FUTURE TRAINING TECHNOLOGY OPPORTUNITIES USING CAREER FIELD MODELS AND SIMULATIONS**

## **INTRODUCTION**

In response to the recent U.S. Quadrennial Defense Review (QDR), the U.S. Military Services are taking an unprecedented top-down look at their entire job and training infrastructure. The Services are attempting to identify ways to significantly reduce the resources required for providing education and training development and delivery. The options being considered include privatizing education and training using the civilian training establishment, eliminating courses altogether, and applying advanced training technologies to in-residence and field training to reduce the time required for training and to increase the efficiency and effectiveness of the process. At the same time, the Military has been challenged by the QDR to continue to provide career learning opportunities for personnel. One of the most pressing issues is related to identifying the most cost-effective places within the education and training system for applying one or more of the options. Further, decision makers must evaluate these options by examining the life-cycle costs associated with each option within and across military career fields.

Given recent reductions in manpower, personnel, and training (MPT) and the continued pressure to "rightsize" the Air Force to meet current defense demands, finding effective ways to assess the impact of education and training options becomes especially critical. Conventional approaches to assessing the value-added or benefit of human resources interventions and organizational change have attempted to relate the intervention directly to measures of organizational productivity in a traditional utility analysis approach (e.g., Cascio, 1989). In general, utility analysis uses an estimate of the validity of a personnel intervention, such as a personnel selection method or a training program, and translates this parameter into organizational productivity in terms of dollars. However, certain aspects of implementing utility approaches have presented problems (e.g., Greer & Cascio, 1987). In addition, utility analysis may be quite limited as a method of determining the benefit one might actually expect from a training program if the effects of suspected moderators cannot be conceptualized easily with respect to the training program (Cascio, 1989).

For example, the Air Force training community may be interested in identifying the significant cost drivers associated with implementing and maintaining advanced technology training programs. In addition, they might be interested in the extent to which course could be refined, shortened, or exported to the field using advanced training technologies. In many instances, implementing some type of training technology may not be immediately or near-term cost effective. By implementing changes such as these, we have impacted our previous estimates of the value-added or utility of the previous course or training pipeline. This is due to the fact that there may be significant up-front costs associated with procuring equipment to support the new technology. In addition, there are inevitable, periodic, updates to the courseware and to the support infrastructure. There are also somewhat less tangible costs associated with potential changes in the quality of graduates once the technology-based course has been implemented. Therefore, new validation studies and examinations must be undertaken when changes such as these are made.

This report argues that the use of probability-based organizational simulation provides a more flexible method for assessing intervention utility under a variety of types of organization reengineering. The ability of training utility analysis to reflect organizational impact will be further eroded if Cascio's (1995) predictions about the fluidity of work and the continued integration of technology in the next generation of organizations are realized.

A promising and recently proven alternative approach to the assessment of the impact of change involves the use of a probability-based, organizational simulation technology such as the Training Impacts Decision System, or TIDES; (see Mitchell, Yadrick, & Bennett; 1993; Vaughan & Yadrick, 1992). TIDES was developed by the U.S. Air Force for assessing the effects of these activities. The simulation has the analytic capability to (a) provide a measure of training utility, expressed as changes in overall training costs and changes in the requirements for, and availability of, qualified personnel; (b) quantify the reduction in requirements such as travel-to-school for additional training in some areas; and (c) estimate the "life-cycle" costs and benefits of change in a variety of terms of relevance to senior managers.

The TIDES model relates micro-level personnel and training events to macro-level outcome variables. Data for TIDES comes from a variety of sources, including job and training analysis, existing MPT data bases, and subject-matter expert judgments. A computer simulation provides information on the flow of individuals through jobs, task performance requirements, and various formal and informal (e.g., on-the-job) training requirements. From these individual events, the system estimates task-level, on-the-job training events. Finally, the system estimates overall training resource requirements, costs, and capacities from the task-level events. Once the computer simulation of the current flows (the baseline) has been developed, plausible alternative flows and job and training structuring can be developed and new simulations can be conducted. Results from the alternative simulation outcomes can be compared to the baseline to examine impacts associated with the alternatives.

## **METHOD**

The Air Force Office of the Surgeon General requested analyses to determine if developing exportable training courses, based in the in-residence course currently being provided, could reduce the travel-to-school costs and requirements for Reserve medical personnel, while maintaining their task-level proficiency. The goal of the request was to quantify the impact and to determine if sufficient resources would be saved to “pay for” the development and delivery of training in an exportable medium. This study conducted a series of comparative analyses across a range of career fields and in-residence courses to examine the costs and benefits of technology insertion for reducing travel-to-school costs while maintaining current proficiency levels. The chosen career fields were Aerospace Physiology; Electronics, Computer, & Switching Systems; and Aerospace Propulsion. Table 1 presents information on the student flow and size of each career field’s training courses.

TABLE 1. Summary Information for Each Career Field and Courses

Key Information	Aerospace Physiology	Electronics, Computers & Switching Systems	Aerospace Propulsion
Average Force Level	518	2,774	10,412
Average Trainees Per Year	154	1,266	2,141
Accessions Per Month	4	34	60
Number of Initial Skills Courses	1	10	4
Hours of Initial Skills CBT	122	1,588	202
Average Number of Trainees in Upgrade Training Per Year	20	26	107
Number of Upgrade Training Courses	3	4	2
Hours of Exportable Upgrade CBT	338	530	49

### PROCEDURE

Although space limitations preclude a detailed discussion of the mechanics of the process here, a full description of this simulation, including the essential assumptions, is available from the first author. Several assumptions about the nature of technology insertion were made so that changes to the underlying models could be developed and implemented. For each of the career field chosen for comparative study, it was assumed that roughly 70% of the current stand-up lecture-based in-residence and upgrade training courses, could be delivered in a computer-based mode in 30% less time. For modeling purposes then, 70% of the in-residence and the upgrade training course time was reduced an average of 30%, i.e., 70% of the course was taught in 30% less time, reducing course length by 21% on average. The reduction in course length results in training dollar savings since airmen are in residence for the course for a shorter duration of time, or not on duty during training for upgrade courses. In addition, it was assumed that the existing proficiency levels produced by the changed content areas would be constant. In other words, the level of proficiency that was being produced by the courses would be the same after the change, as they were before the change.

An estimate of the costs of purchasing and implementing a computer-based training classroom to support the new course was added as an additional training cost for the initial year of the new course. These costs were assumed to require the purchase of computer hardware systems for the in-residence initial skills courses. It was assumed that the number of systems purchased would be based upon the number of new airmen entering initial skills courses for the AFS being



considered. For upgrade training, it was assumed that no computer hardware would be purchased. It was assumed that all upgrade training would occur at the base to which the airman was assigned and on existing computer hardware. Further, in subsequent years, costs for maintenance and upgrade to course content and hardware maintenance were included. No hardware maintenance costs were included for upgrade training since training would be performed on pre-existing hardware systems. Assumptions were also made concerning travel-to-school requirements. Initial skills courses would remain in residence so no change would be made in existing travel-to-school requirements. Upgrade training would now be performed at the airman's current base assignment, therefore eliminating all travel-to-school requirements for upgrade training. Table 2 provides a summary of these additional assumptions and cost figures.

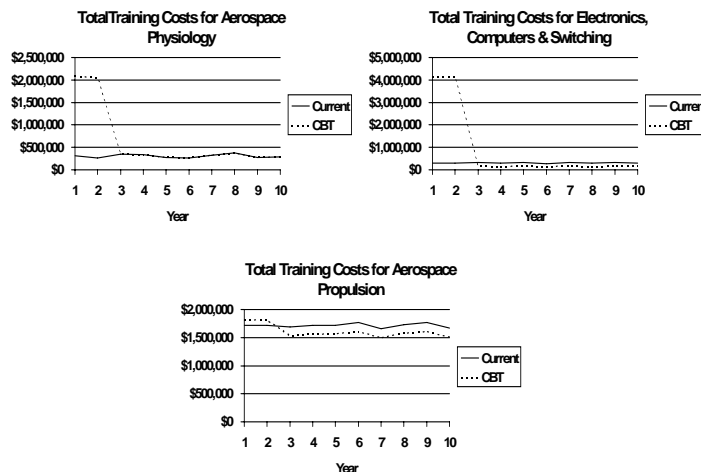
TABLE 2. Additional Assumptions

Cost Category	Implementation of Initial Skills Course CBT	Implementation of Exportable Upgrade CBT
Acquisition Costs		
▪ Hardware	\$2,000 per Monthly Accession	\$0
▪ Course Development	\$50 per Development Hour. 300 Development Hours per Hour of CBT	\$50 per Development Hour. 300 Development Hours per Hour of CBT
▪ Maintenance	\$50 per 3 Hours of Delivered CBT	\$0
Travel-to-School Requirements		
▪ Initial Skills Training	No Change	
▪ Upgrade Training		Eliminated

## RESULTS

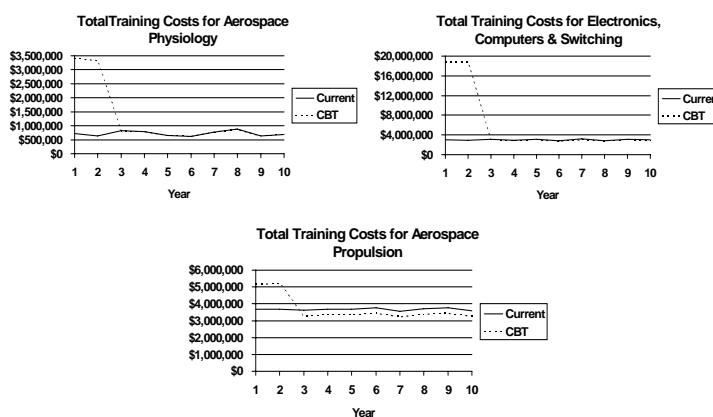
Figure 1 shows the results of our simulation and the impact of developing an exportable upgrade course using CBT for each career field. As the figures for each career field demonstrate, there are savings in travel-to-school costs associated with this specific change, but only for the career fields with the larger student flows and shortest upgrade training course (e.g., Aerospace Propulsion and Electronics, Computers, & Switching, respectively). Also note that the simulation results permit assessments of the time required, in years, before there is a return on the investment in this type of training. In the present analysis, there is "break even" point at about three years and savings in subsequent years, especially in Aerospace Propulsion.

Figure 1. Career Field Summary Analyses of Total Training Costs for Exportable Upgrade Training Courses



The next step in the analysis was to assess the combined effect of using CBT in the initial skills and in the upgrade training for each of the career fields. Figure 2 presents the results from these combined analyses. Again, these analyses demonstrate that there are savings to be realized from the conversion of both the initial skills and upgrade training course for the two larger career fields – Aerospace Propulsion and Electronics, Computers and Switching – but not for Aerospace Physiology.

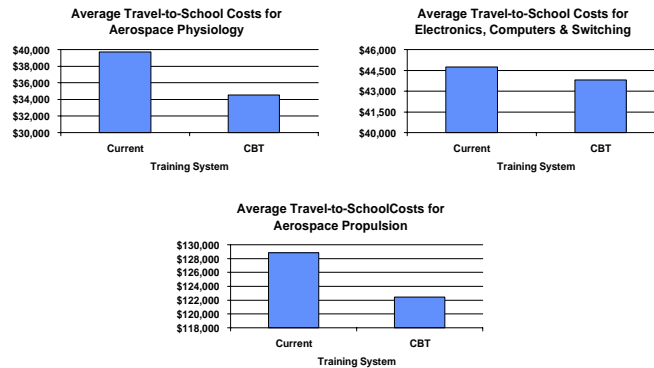
Figure 2. Career Field Summary Analyses of Total Training Costs for Initial Skills and Exportable Upgrade Training Courses



The final analyses were conducted to determine the savings, if any, on travel-to-school costs. As mentioned earlier, these costs were of special interest to the Air Force Surgeon

General as a means of assessing a potential benefit of CBT for exportable training in the future. Figure 3 provides the results of these analyses.

Figure 3. Career Field Summary Analyses of Travel-to-School Costs



## DISCUSSION

The results indicate that there are potential savings to be realized from the introduction of advanced training technology into these courses. However, these analyses demonstrate that there are some key characteristics of the underlying courses and the size of the career field that dictate the extent of any savings of benefit impact from change. For example, there is clear utility from the application of CBT for Aerospace Propulsion. This career field is also one of the largest in terms of student flow, and of moderate size with respect to the number of hours to be converted. In comparison, Electronic, Computers, and Switching has a number of courses to be converted, the number of hours associated with them is quite large, and although the student flow is fairly high, the combination of these factors limits the short-term savings to be realized from CBT. In contrast, Aerospace Physiology is a relatively small career field with low student flow. Although it has a small number of course hours to be converted and although it has few courses overall, there are very little if any savings to be gained by applying CBT to this career field.

It is also important to note that one of the major points of this study was to demonstrate the potential use of simulations for identifying cost-effective opportunities for technology insertion. As the results indicate, organizational simulations offer considerable insight and data for

decision making in support of training restructuring and change. In addition, the simulations can be developed and executed before budgetary and related resources decisions are made. This can ensure a more efficient and effective use of the Military's shrinking resources for training.

In summary, the analyses presented here were provided to the Air Force Office of the Surgeon General. After careful review of these results, it was determined that CBT could be implemented, in a systematic way, to realize travel-to-school savings without sacrificing the proficiency of the graduates from the training. Additional analyses are being conducted with the U.S. Air Force Education and Training Command to identify areas where maintenance training costs can be substantially reduced using advanced training technologies.

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